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RESEARCH MEMORANDUM

for the

Air Research and Development Command, U.S. Air Force

PRELIMINARY ALTITUDE PERFORMANCE DATA FOR THE J65-B3 TURBOJET ENGINE AT REYNOLDS NUMBER INDICES FROM 0.2 TO 0.8

By W. M. Braithwaite and W. K. Greathouse

Lewis Flight Propulsion Laboratory
Cleveland, Ohio

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WASHINGTON

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SUMMARY

Altitude performance characteristics of the J65-B3 turbojet engine and its components were obtained at engine-inlet conditions corresponding to Reynolds number indices from 0.2 to 0.8 over a range of corrected engine speeds from 70 to 110 percent of rated speed. Engine operational limits up to an altitude of 75,000 feet together with ignition and windmilling characteristics were also obtained. The engine and component data are presented both in graphical and in tabulated form. The operational characteristics are presented in graphical form.

INTRODUCTION

At the request of the Air Research and Development Command, U.S. Air Force, an experimental investigation of performance of the J65-B3 turbojet engine was made in an NACA Lewis altitude chamber. Preliminary results of this investigation are presented herein for a range of engine-inlet conditions corresponding to Reynolds number indices from 0.2 to 0.8 and corrected engine speeds from 5800 (70 percent rated) to 9200 (110 percent rated) rpm. Engine operational limits and ignition and windmilling characteristics are also presented. Over-all engine and component performance are shown, in terms of conventional parameters for the various Reynolds number indices, as plotted curves and also in tabulated form. Engine operational limits between 60,000 and 75,000 feet altitude were obtained by utilizing a no-flow ejector at the exhaust-nozzle exit. A fixed engine exhaust-nozzle area of 1.969 square feet was used throughout the investigation.

APPARATUS

Engine

The J65-B3 axial-flow turbojet engine (fig. 1) has a rated thrust of 7220 pounds at standard sea-level static operation at an engine speed of 8300 rpm and a limiting turbine-discharge temperature of 1166° F (1626° R). For this investigation, the fixed exhaust nozzle was sized to an area of 1.969 square feet which gave limiting turbine-discharge temperature (1166° F) at 8300 rpm for 100° F inlet-air temperature at sea-level static operation.

Instrumentation

Location of instrumentation stations throughout the engine and the amount of instrumentation at each station are shown in the diagram and table in figure 2. Engine fuel was measured by rotometers and engine thrust was measured with a null-type thrust cell.

PROCEDURE

Performance data were obtained at Reynolds number indices from 0.2 to 0.8 and corrected engine speeds from 5800 to 9200 rpm. At each Reynolds index, the maximum engine-inlet ram-pressure ratio available from the test facility was maintained while engine speed was varied from rated engine speed down to the engine speed at which the exhaust nozzle "unchoked." Engine operational limits were determined over a range of altitudes at a Mach number of 0.8. Determination of operational characteristics between altitudes of 60,000 and 75,000 feet was made possible by utilizing a no-flow ejector to reduce the static pressure surrounding the exhaust nozzle. Fuel flows less than that corresponding to the J65-B3 throttle setting of "idle" were obtained by use of a separate "modified" fuel control. MIL-5-5624A, grade JP-4 fuel was used throughout the investigation.

PRESENTATION OF RESULTS

The experimental data are grouped according to the index presented in table I. Over-all engine performance is shown in figure 3 and component performance is shown in figures 4 to 7.

The performance of the engine was measured and presented in a manner similar to that reported in reference 1. Therefore, within the range of Reynolds number indices covered, engine performance may be determined from the curves presented for any flight condition at which the

engine exhaust nozzle is choked. In order to calculate the jet thrust for the engine at a particular flight condition from figure 3(e), the exhaust-nozzle pressure-drop parameter must be determined by using figures 3(c) and (d). Subtracting the inlet momentum term from this jet thrust will give the net thrust. The corrected net thrust and specific fuel consumption at a flight Mach number of 0.8 are presented in figures 3(f) and 3(g) for a range of altitude corresponding to the range of Reynolds number indices investigated.

The data of figure 8 are presented to show the difference between the exhaust-gas temperature as measured by the 4 thermocouples on the manufacturer's thermocouple harness at the turbine outlet and the average temperature as measured by 30 thermocouples installed at the exhaust-nozzle inlet. The oil-mist-overboard air flow and turbine-flange cooling air flow are shown in figure 9.

The operational range of the engine is presented in figure 10 for a flight Mach number of 0.80 and superimposed on the range is the windmilling speed and the manufacturer's throttle idle position setting. Windmilling and ignition characteristics are presented in figures 11 and 12. The procedure followed in determining the ignition characteristics was prescribed by the manufacturer. All ignitions presented on the figure were therefore obtained in the 20-second time interval which is incorporated into the ignition system.

The corrected engine speed at which the exhaust-nozzle chokes is presented in figure 13 and the data reported herein represent the performance of the engine only in the region where the exhaust nozzle is choked. The relation between Reynolds number index and flight conditions is shown in figure 14. A complete tabulation of the performance data is presented in table II and the symbols used in the various parameters are defined in the appendix.

Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio, August 23, 1954

APPENDIX A

SYMBOLS

The following symbols are used in this report:

F_j	jet thrust, lb
F_n	net thrust, lb
M	Mach number
N	engine speed, rpm
P	total pressure, lb/sq ft
p	static pressure, lb/sq ft
T	total temperature, $^{\circ}R$
t	static temperature, $^{\circ}R$
V	velocity, ft/sec
W_a	air flow, lb/sec
W_f	fuel flow, lb/sec
W_g	gas flow, lb/sec
W_{om}	oil mist overboard air flow, lb/sec
W_{tf}	turbine flange cooling air flow, lb/sec
γ	ratio of specific heats of gas
δ	ratio of absolute total pressure to absolute static pressure of NACA standard atmosphere at sea level
η	efficiency
θ	ratio of absolute total temperature to absolute static temperature of NACA standard atmosphere at sea level
φ	ratio of absolute viscosity of air to absolute viscosity of air of standard NACA atmosphere at sea level
$\dfrac{\delta}{\varphi\sqrt{\theta}}$	Reynolds number index

Subscripts:

b	combustor
c	compressor
e	engine
t	turbine
0	altitude test condition
1	compressor inlet
3	compressor discharge
4	turbine inlet
5	turbine discharge
6	manufacturer's temperature measuring station
9	exhaust-nozzle inlet

REFERENCE

1. Walker, Curtis L., Braithwaite, Willis M., and Fenn, Daniel B.: Component and Over-All Performance Evaluation of a J47-GE-25 Turbojet Engine over a Range of Engine-Inlet Reynolds Number Indicies. NACA RM E52L16, 1953.

TABLE I. - FIGURE INDEX

Figure	Dependent variable	Independent variable
1	Engine installation	
2	Sectional view of J65-B3 turbojet engine	
	Over-all Engine Performance	
3(a)	Corrected engine air flow	Corrected engine speed
3(b)	Corrected fuel flow	Corrected engine speed
3(c)	Corrected exhaust-gas total temperature	Corrected engine speed
3(d)	Engine total-pressure ratio	Engine total-temperature ratio
3(e)	Jet thrust	Exhaust-nozzle pressure-drop parameter
3(f)	Corrected net thrust	Corrected engine speed
3(g)	Corrected specific fuel consumption	Corrected engine speed
	Component Performance	
4	Compressor performance	Corrected engine speed
5	Combustor performance	Combustion parameter and corrected engine speed
6	Turbine performance	Corrected engine speed
7	Tail-pipe total-pressure loss	Corrected engine speed
	Operational Characteristics	
8	Manufacturer's 4 thermocouple temperature average	Nozzle-inlet total temperature
9	Oil mist and turbine cooling air flow	Engine-inlet air flow
10	Altitude (operational)	Acutal engine speed
11	Ratio of windmilling engine speed to rated speed	Corrected flight velocity
12	Altitude (ignition)	Mach number
13	Exhaust-nozzle choked-flow range	
14	Relation between Reynolds number index and flight condition.	

Table II. - Calibration of J65-B3 Turbojet Engine.

Run	Combustor total-pressure loss, $\frac{P_3-P_4}{P_3}$	Tail-pipe total-pressure loss, $\frac{P_5-P_9}{P_5}$	Exhaust-nozzle pressure-drop parameter, $1.26\ P_9-p_0$	Scale jet thrust, F_j, lb	Engine speed, N, rpm	Corrected engine speed, $\frac{N}{\sqrt{\theta_1}}$, rpm	Corrected engine air flow, $\frac{W_{a,1}\sqrt{\theta}}{\delta}$, lb/sec	Corrected fuel flow, $\frac{W_{f,e}}{\delta\sqrt{\theta}}$, lb/hr	Ram pressure ratio, $\frac{P_1}{p_0}$	Engine total-pressure ratio, $\frac{P_9}{P_1}$	Engine total-temperature ratio, $\frac{T_9}{T_1}$	Compressor: Total-pressure ratio, $\frac{P_3}{P_1}$	Compressor: Efficiency, η_c	Combustor: Combustion parameter, $\frac{p_b^2}{W_{a,1}-W_{om}}$	Combustor: Efficiency, η_b	Turbine: Corrected gas flow, $\frac{W_{g,4}\sqrt{\theta_4}}{\delta_4}\frac{\gamma_4}{1.4}$, lb/sec	Turbine: Efficiency, η_t	Turbine: Corrected inlet total temperature, $\frac{T_4}{\theta}$, °R	Turbine: Total-pressure ratio, $\frac{P_4}{P_5}$	Corrected exhaust-gas total temperature, $\frac{T_9}{\theta_1}$, °R
1	0.050	0.037	1038	1888	5846	5765	65.6	696	2.18	0.8344	1.423	2.528	0.769	3528x10^2	0.973	36.31	0.882	943	2.771	739
2	.042	.038	1397	2597	6205	6119	74.1	1183	2.18	.9977	1.627	3.033	.814	4545	.947	36.65	.895	1080	2.801	844
3	.044	.040	1751	3393	6507	6417	80.9	1689	2.21	1.152	1.800	3.532	.847	5651	.932	36.46	.909	1194	2.815	934
4	.043	.037	1980	3788	6696	6604	85.4	2058	2.17	1.264	1.946	3.867	.860	6379	.962	36.58	.896	1284	2.822	1010
5	.043	.036	2274	4379	6886	6784	91.0	2508	2.18	1.396	2.082	4.259	.875	7286	.971	36.67	.900	1372	2.814	1081
6	0.041	0.027	2729	5282	7239	7132	98.5	3283	2.18	1.595	2.320	4.815	0.873	8698	0.994	37.29	0.897	1520	2.816	1204
7	.040	.025	3040	5911	7440	7337	103.6	3872	2.21	1.735	2.478	5.222	.867	9732	.994	37.55	.901	1618	2.819	1286
8	.039	.025	3479	6829	7807	7699	111.2	4956	2.17	1.947	2.728	5.861	.859	11530	.985	37.47	.899	1775	2.822	1416
9	.037	.029	4030	7989	8199	8094	118.8	6225	2.22	2.185	3.011	6.565	.854	13500	.997	38.00	.896	1948	2.809	1563
10	.038	.027	4061	8003	8239	8149	118.7	6333	2.20	2.215	3.021	6.602	.850	13520	.984	37.87	.902	1955	2.796	1568
11	0.047	0.038	815	1564	5919	5855	66.1	809	2.19	0.859	1.480	2.605	0.761	2780	0.944	36.30	0.895	982	2.781	768
12	.042	.038	1099	2074	6268	6194	77.2	1327	2.15	1.041	1.688	3.167	.824	3526	.974	37.31	.892	1117	2.804	876
13	.043	.037	1400	2697	6598	6526	83.2	1940	2.19	1.215	1.906	3.705	.843	4490	.958	36.81	.901	1260	2.812	989
14	.043	.032	1689	3275	6880	6798	91.4	2559	2.20	1.392	2.096	4.226	.865	5307	.965	37.31	.897	1379	2.815	1088
15	.042	.027	1997	3878	7174	7089	97.7	3404	2.18	1.585	2.329	4.789	.861	6387	.956	37.29	.898	1527	2.817	1209
16	0.039	0.025	2264	4371	7454	7366	104.2	4010	2.18	1.751	2.508	5.287	0.868	7357	0.993	37.56	0.902	1639	2.830	1302
17	.039	.024	2494	4876	7653	7555	109.2	4680	2.15	1.896	2.655	5.709	.869	8166	.983	37.56	.895	1727	2.824	1378
18	.039	.025	2762	5390	7931	7829	113.8	5533	2.16	2.063	2.856	6.167	.860	9135	.977	37.74	.901	1853	2.804	1482
19	.037	.029	2965	5840	8126	8046	117.4	6328	2.16	2.180	3.032	6.516	.817	9932	.973	37.90	.887	1956	2.796	1574
20	.037	.028	2995	5916	8187	8082	118.1	6385	2.18	2.190	3.047	6.560	.851	10072	.983	37.97	.854	1966	2.804	1581
21	0.046	0.037	1209	2292	6181	6544	85.6	1978	2.21	1.242	1.933	3.782	0.851	3528	0.985	37.22	0.899	1281	2.797	1003
22	.045	.029	1552	2997	6578	6942	94.4	2888	2.19	1.485	2.221	4.508	.863	4639	.983	37.12	.895	1465	2.815	1153
23	.043	.025	1894	3593	6937	7360	104.9	3968	2.18	1.751	2.523	5.278	.875	5107	.990	37.47	.890	1654	2.814	1309
24	.039	.028	2152	4125	7251	7693	112.2	4886	2.17	1.966	2.731	5.917	.853	6590	1.988	37.60	.912	1791	2.811	1423
25	.040	.026	2163	4177	7254	7697	112.2	4848	2.18	1.946	2.742	5.879	.847	6576	1.003	37.65	.906	1797	2.823	1439
26	0.041	0.024	2207	4299	7286	7706	111.9	4946	2.21	1.966	2.772	5.913	0.849	6727	1.002	37.87	0.915	1811	2.818	1417
27	.040	.024	2386	4628	7483	7949	117.1	5596	2.21	2.115	2.926	6.314	.840	7222	1.011	38.19	.906	1909	2.798	1519
28	.037	.026	2567	5021	7771	8245	120.5	6421	2.17	2.245	3.102	6.778	.829	8154	1.004	37.77	.901	2021	2.830	1610
29	.035	.026	2710	5295	7965	8433	125.1	7093	2.15	2.366	3.235	7.113	.826	8634	1.010	38.17	.898	2102	2.825	1679
30	.034	.026	2880	5599	8156	8635	127.0	7749	2.18	2.476	3.378	7.386	.814	9236	1.003	38.14	.899	2189	2.805	1753
31	0.034	0.027	2928	5700	8229	8751	128.2	----	2.18	2.540	3.471	7.557	0.806	9412	-----	-----	----	----	2.797	1801
32	.041	.026	774	1383	6440	6846	92.3	2998	1.17	1.514	2.273	4.448	.864	3077	0.964	36.87	0.888	1487	2.744	1180
33	.041	.025	870	1640	6684	7061	97.6	3480	1.20	1.609	2.409	4.820	.861	3396	.973	37.30	.881	1576	2.799	1250
34	.040	.022	990	1887	6900	7289	103.0	4016	1.20	1.738	2.560	5.214	.856	3785	.986	37.57	.870	1582	2.814	1329
35	.040	.027	1093	2094	7108	7493	108.1	4535	1.19	1.852	2.668	5.607	.855	4206	.992	37.75	.893	1744	2.827	1385
36	0.038	0.024	1275	2472	7393	7802	113.5	5482	1.21	2.035	2.897	6.178	0.847	4889	0.993	37.52	0.883	1886	2.853	1504
37	.039	.024	1291	2516	7381	7849	114.3	5544	1.22	2.066	2.915	6.192	.840	4770	0.994	37.87	.894	1898	2.813	1513
38	.038	.024	1371	2694	7566	8011	117.6	6021	1.20	2.152	3.032	6.497	.836	5168	1.000	37.94	.889	1972	2.836	1574
39	.035	.025	1552	2975	7890	8345	123.1	7148	1.17	2.361	3.263	7.071	.827	5893	0.998	37.86	.885	2111	2.817	1693
40	.034	.025	1643	3243	8067	8532	125.1	7698	1.18	2.456	3.401	7.299	.813	6179	1.000	38.10	.890	2197	2.799	1765
41	0.034	0.025	1723	3424	8193	8665	126.5	8186	1.22	2.523	3.504	7.482	0.804	6424	1.010	38.18	0.887	2258	2.793	1819
42	.040	.035	611	1177	6024	6811	92.3	2834	1.19	1.461	2.229	4.325	.844	2280	.970	37.39	.900	1470	2.743	1157
43	.038	.029	748	1474	6300	7140	99.3	3552	1.20	1.631	2.423	4.918	---	2746	.966	36.97	.882	1596	2.815	1258
44	.040	.028	763	1510	6349	7214	100.8	3721	1.21	1.650	2.463	5.059	.846	2817	.970	36.96	.886	1622	2.853	1278
45	.039	.027	865	1740	6573	7459	107.8	4381	1.20	1.806	2.628	5.546	.850	3142	.981	37.36	.883	1732	2.870	1364
46	0.040	0.025	973	1943	6795	7701	111.3	5103	1.21	1.935	2.802	5.904	0.832	3470	0.957	37.47	0.861	1829	2.854	1454
47	.038	.024	1120	2135	7010	7925	116.0	5761	1.22	2.123	2.956	6.363	.834	3908	.976	37.49	.903	1938	2.814	1534
48	.038	.025	1302	2541	7470	8216	121.6	6805	1.18	2.297	3.179	7.003	.843	4878	.976	37.19	.878	2066	2.860	1650
49	.035	.029	1276	2528	7387	8288	123.3	6700	1.18	2.289	3.201	6.955	.819	4599	1.015	38.02	.893	2091	2.848	1661
50	.035	.027	1427	2800	7753	8538	124.4	7504	1.18	2.438	3.374	7.345	.808	5297	1.000	37.48	.896	2194	2.828	1751
51	0.032	0.027	1677	3335	8278	9209	130.3	10174	1.19	2.798	3.892	8.285	0.756	6202	0.956	37.56	0.906	2515	2.788	2020
52	.040	.042	524	967	6185	6884	92.0	2913	1.28	1.497	2.277	4.465	.834	1922	.982	36.85	.920	1504	2.745	1182
53	.038	.028	724	1451	6704	7524	106.4	4668	1.26	1.840	2.723	5.672	.838	2673	.967	36.70	.872	1788	2.883	1413
54	.038	.025	828	1582	6882	7687	110.1	5216	1.25	2.015	2.839	6.050	.844	2980	.957	36.63	.905	1860	2.817	1473
55	.042	.026	855	1708	7087	7878	115.7	5847	1.24	2.054	2.979	6.344	.833	3105	.973	37.82	.875	1945	2.884	1546
56	0.035	0.024	970	1839	7278	8062	117.4	6479	1.26	2.255	3.111	6.787	0.840	3539	0.962	36.49	0.889	2027	2.835	1615
57	.035	.028	1188	2302	7874	8742	127.8	8533	1.28	2.573	3.591	7.702	.790	4238	.996	37.94	.894	2326	2.808	1864
58	.035	.027	1191	2312	7913	8838	126.2	8960	1.27	2.627	3.700	7.877	.784	4372	.976	37.10	.886	2392	2.819	1920
59	.038	.029	533	1030	6653	7431	102.13	4644	1.76	1.822	2.750	5.566	.826	1756	.956	36.08	.876	1802	2.853	1427
60	.039	.031	567	1113	6675	7429	104.20	4664	2.10	1.835	2.757	5.595	.840	1789	.975	36.84	.876	1798	2.841	1431
61	0.038	0.027	626	1206	6854	7683	106.26	5527	2.01	2.003	2.949	6.117	0.826	2027	0.933	35.63	0.886	1928	2.858	1531
62	.039	.024	711	1396	7118	7979	114.73	6474	2.10	2.168	3.169	6.565	.813	2203	.977	37.50	.871	2055	2.839	1645
63	.036	.024	825	1610	7495	8402	123.66	8122	2.14	2.476	3.501	7.408	.806	2580	.969	37.50	.873	2259	2.816	1817
64	.035	.024	868	1654	7815	8760	126.5	9499	2.01	2.661	3.780	7.997	.788	2285	.952	37.03	.870	2434	2.831	1962
65	.033	.028	916	1820	7988	8944	128.11	9953	2.17	2.696	3.918	8.141	.768	3040	.972	37.63	.871	2516	2.840	2033

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Table II. - Concluded. Calibration of J65-B3 Turbojet Engine.

Run	Inlet Reynolds number index, $\frac{\delta}{\varphi\sqrt{\theta}}$	Inlet total pressure, P_1, lb/sq ft abs	Altitude static pressure, p_0, lb/sq ft abs	Inlet total temperature, T_1, °R	Compressor outlet		Turbine inlet		Turbine outlet		Nozzle inlet		Manufacturer's thermocouple average, T_6, °R	Engine inlet air flow, $W_{a,1}$, lb/sec	Oil mist overboard air flow, W_{om} lb/sec	Turbine flange cooling air, W_{tf} lb/sec	Fuel flow, $W_{f,e}$, lb/hr
					Total pressure, P_3, lb/sq ft abs	Total temperature, T_3, °R	Total pressure, P_4, lb/sq ft abs	Total temperature, T_4, °R	Total pressure, P_5, lb/sq ft abs	Static pressure, p_5, lb/sq ft abs	Total temperature, T_9, °R	Total pressure P_9, lb/sq ft abs					
1	0.798	1751	803	534	4426	745	4204	970	1517	1364	760	1461	762	53.54	0.84	0.76	584
2	.797	1748	800	534	5301	779	5078	1111	1813	1621	869	1744	865	60.35	0.92	.89	991
3	.800	1755	795	534	6198	808	5928	1229	2106	1885	961	2021	967	66.18	1.00	1.01	1421
4	.797	1749	805	534	6763	827	6473	1321	2294	2091	1039	2210	1034	69.64	1.04	1.09	1725
5	.795	1747	800	535	7441	849	7119	1414	2530	2291	1114	2440	1066	73.99	1.09	1.19	2102
6	0.800	1759	805	535	8469	883	8119	1567	2883	2623	1241	2805	1186	80.71	1.16	1.33	2770
7	.799	1753	793	534	9155	906	8793	1665	3119	2830	1323	3042	1283	84.69	1.18	1.42	3253
8	.796	1746	804	534	10234	943	9839	1826	3486	3174	1457	3399	1428	89.62	1.26	1.56	4138
9	.802	1755	790	533	11521	978	11093	2001	3949	3606	1605	3835	1558	97.28	1.33	1.71	5230
10	.798	1738	789	531	11507	978	11055	2000	3954	3616	1604	3849	1590	96.45	1.32	1.65	5259
11	0.599	1304	596	531	3397	751	3237	1005	1164	1045	786	1120	783	40.28	0.63	0.59	504
12	.594	1298	603	532	4111	784	3940	1145	1405	1258	898	1351	893	46.82	.69	.69	824
13	.598	1303	595	531	4828	817	4620	1289	1643	1470	1012	1583	1007	50.71	.75	.78	1208
14	.595	1300	590	532	5494	846	5259	1414	1868	1688	1115	1809	1103	55.49	.79	.89	1591
15	.595	1299	597	532	6221	881	5960	1565	2116	1918	1239	2059	1180	59.25	.84	.97	2115
16	0.596	1301	606	532	6879	906	6610	1680	2336	2120	1334	2278	1288	63.32	0.86	1.06	2495
17	.592	1296	602	533	7399	929	7110	1774	2518	2290	1415	2457	1383	66.04	0.91	1.13	2904
18	.591	1293	598	533	7974	956	7666	1903	2734	2496	1522	2667	1490	68.67	0.94	1.20	3425
19	.597	1298	600	530	8458	972	8144	1997	2913	2664	1607	2829	1590	71.31	1.04	1.26	3920
20	.595	1302	597	533	8541	979	8227	2019	2934	2680	1624	2851	1599	71.72	1.01	1.27	3980
21	0.596	1086	491	463	4107	715	3919	1143	1401	1263	895	1349	889	46.53	0.68	0.72	959
22	.597	1098	502	466	4950	757	4727	1315	1679	1522	1035	1630	1011	51.71	.75	.84	1420
23	.598	1084	497	461	5721	787	5477	1469	1946	1767	1163	1898	1140	57.04	.80	.95	1916
24	.592	1073	507	461	6349	819	6102	1591	2196	1966	1259	2110	1233	60.34	.80	1.03	2335
25	.598	1084	496	461	6373	820	6118	1596	2171	1966	1264	2110	1241	60.95	.81	1.04	2341
26	0.597	1091	494	464	6451	826	6189	1619	2167	2005	1286	2144	1258	61.02	0.83	1.05	2411
27	.597	1079	489	460	6813	840	6544	1692	2339	2135	1346	2282	1328	63.41	.84	1.10	2686
28	.598	1084	500	461	7347	866	7072	1795	2499	2283	1430	2434	1420	65.51	.86	1.16	3100
29	.591	1077	500	463	7661	885	7390	1875	2616	2393	1498	2548	1479	67.44	.86	1.20	3410
30	.594	1083	498	463	7999	902	7724	1953	2754	2523	1564	2681	1543	68.83	.86	1.24	3746
31	0.593	1068	490	459	8071	905	7800	----	2789	2553	1593	2713	1568	68.82	0.84	1.24	3872
32	.400	734	626	461	3265	745	3131	1321	1141	1041	1048	1111	1034	33.95	.50	0.55	980
33	.397	727	604	465	3504	772	3359	1412	1200	1093	1120	1170	1094	35.44	.49	.58	1132
34	.399	730	609	464	3806	791	3653	1491	1298	1183	1188	1269	1159	37.60	.51	.63	1310
35	.397	732	615	467	4104	815	3941	1569	1394	1265	1246	1356	1211	39.41	.51	.67	1488
36	0.399	734	607	466	4535	842	4365	1693	1530	1396	1350	1494	1320	41.55	0.55	0.72	1802
37	.402	724	594	459	4483	833	4309	1679	1532	1401	1338	1496	1309	41.59	.54	.72	1784
38	.400	729	606	463	4736	855	4557	1759	1607	1471	1404	1569	1379	42.90	.54	.75	1959
39	.400	731	623	464	5169	885	4986	1887	1770	1623	1514	1726	1490	44.97	.57	.81	2335
40	.407	730	616	464	5328	901	5147	1964	1839	1686	1578	1793	1529	45.66	.56	.82	2511
41	0.412	730	598	464	5462	913	5278	2019	1890	1733	1626	1842	1573	46.15	0.54	0.84	2670
42	.400	612	515	406	2647	656	2540	1150	926	838	905	894	895	30.16	.40	.49	725
43	.402	612	509	404	3010	680	2894	1242	1028	933	979	998	963	32.54	.44	.54	907
44	.401	606	501	402	3066	682	2944	1260	1032	937	990	1003	975	32.80	.43	.55	938
45	.395	599	498	403	3322	703	3191	1345	1112	1013	1059	1082	1045	34.61	.45	.58	1093
46	0.397	604	500	404	3566	725	3422	1424	1199	1093	1132	1169	1117	36.01	0.46	0.62	1285
47	.395	604	495	406	3843	746	3695	1516	1313	1205	1200	1282	1183	37.42	.47	.66	1454
48	.396	637	541	429	4461	808	4290	1708	1500	1369	1364	1463	1335	40.27	.55	.73	1862
49	.401	626	630	412	4354	785	4201	1660	1475	1343	1319	1433	1288	40.95	.48	.72	1766
50	.390	641	542	428	4708	835	4542	1809	1606	1466	1444	1563	1404	41.49	.48	.76	2064
51	0.395	624	523	416	5170	873	5004	2016	1795	1645	1619	1746	1623	42.91	0.53	0.81	2686
52	.300	475	372	419	2121	687	2037	1214	745	664	954	711	933	22.97	.29	.38	588
53	.304	475	377	412	2694	728	2592	1419	899	813	1122	874	1095	26.80	.35	.46	934
54	.301	476	380	416	2880	748	2772	1491	984	896	1181	959	1152	27.65	.36	.49	1050
55	.299	479	385	420	3039	771	2913	1574	1010	920	1251	984	1220	29.11	.36	.51	1191
56	0.293	474	377	423	3217	790	3104	1652	1095	1001	1316	1069	1283	29.12	0.37	0.53	1310
57	.301	483	378	421	3720	844	3591	1889	1279	1166	1512	1243	1470	32.40	.36	.60	1755
58	.298	472	371	416	3718	843	3592	1917	1274	1165	1539	1240	1511	31.44	.40	.59	1790
59	.1954	309	176	416	1720	735	1655	1444	580	527	1144	563	1111	16.65	.21	.30	607
60	.1935	309	147	419	1729	736	1662	1452	585	529	1155	567	1119	16.93	.21	.30	612
61	0.1974	309	154	413	1890	752	1818	1534	636	579	1218	619	1190	17.39	0.23	0.32	720
62	.2013	315	150	413	2068	775	1987	1635	700	642	1309	683	1279	19.15	.24	.34	860
63	.1987	311	145	413	2304	809	2222	1798	789	722	1446	770	1423	20.38	.25	.38	1065
64	.1943	304	151	413	2431	839	2347	1937	829	759	1561	809	1534	20.37	.27	.38	1218
65	.1985	312	144	414	2540	857	2457	2007	865	791	1622	841	1599	21.14	.25	.40	1310

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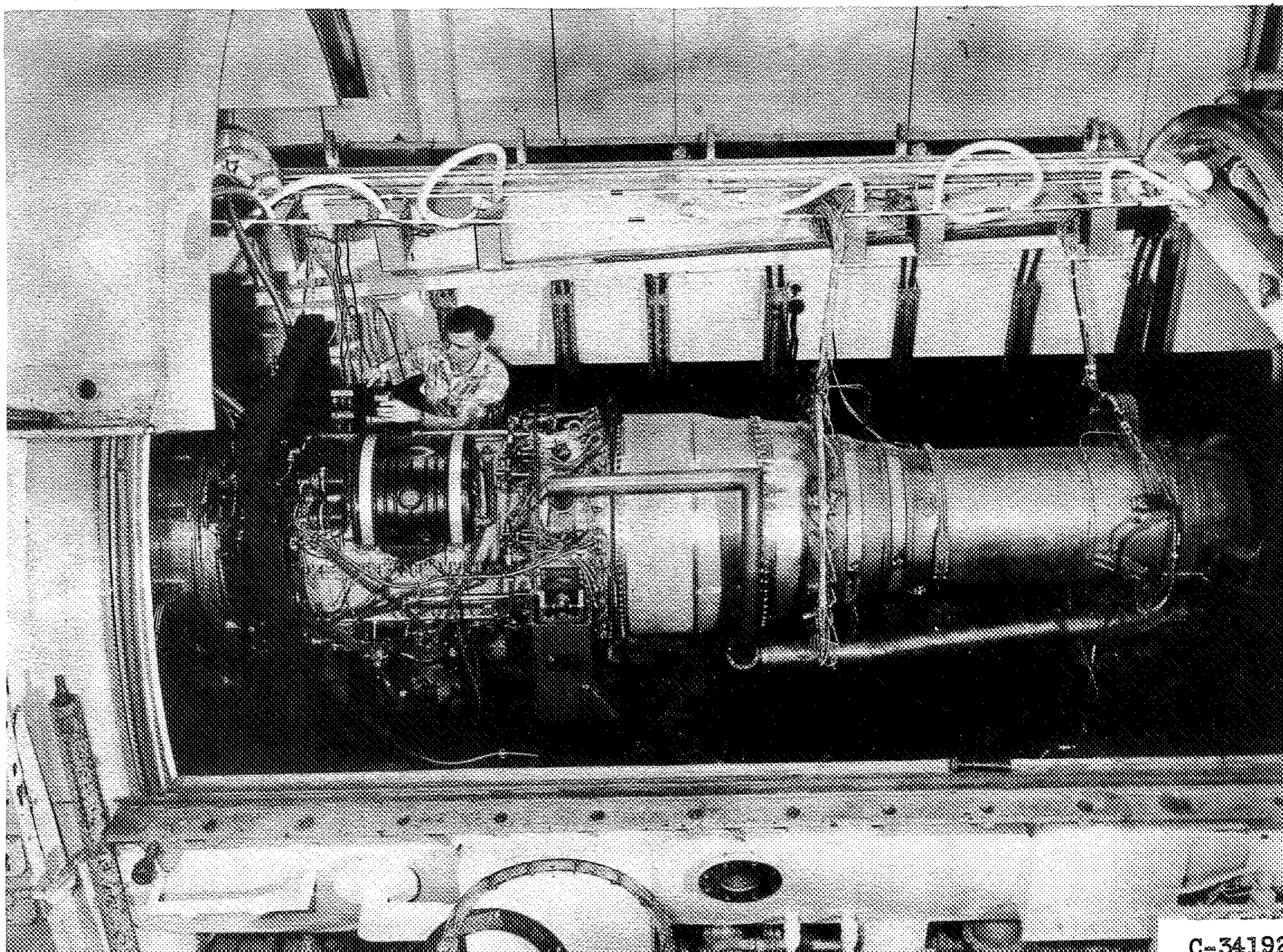

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Figure 1. - J65-B3 turbojet engine in altitude test chamber.

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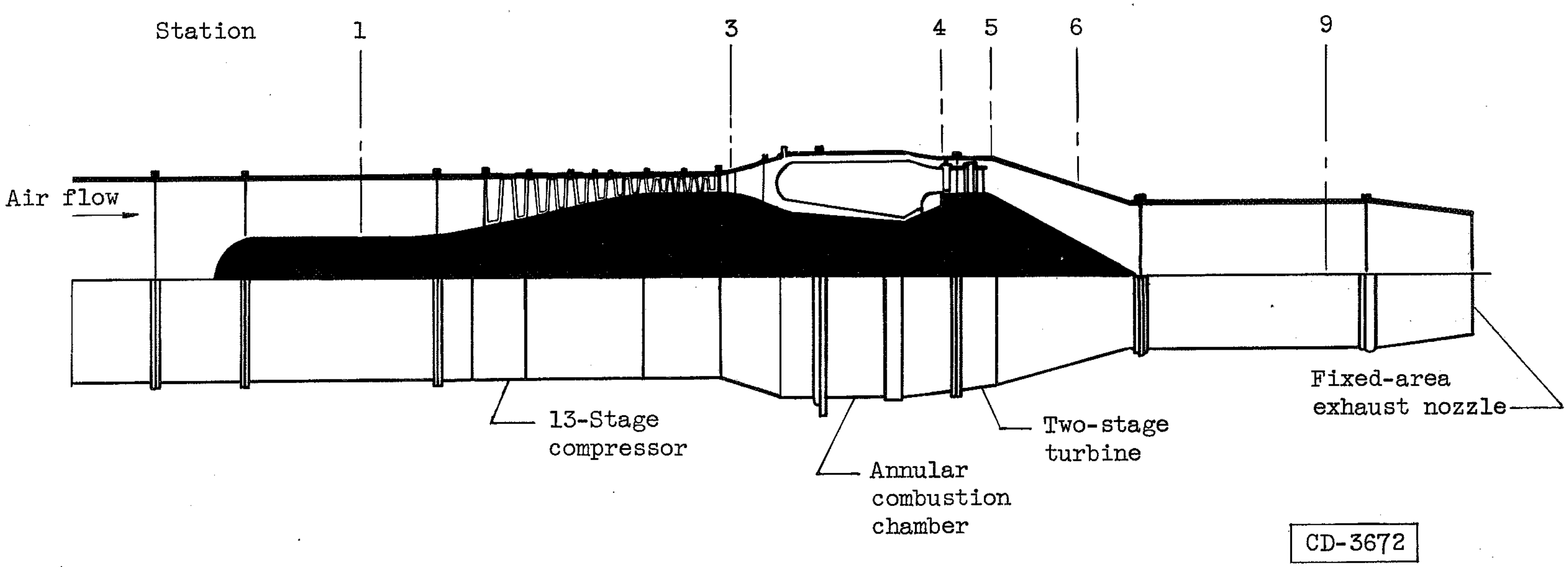
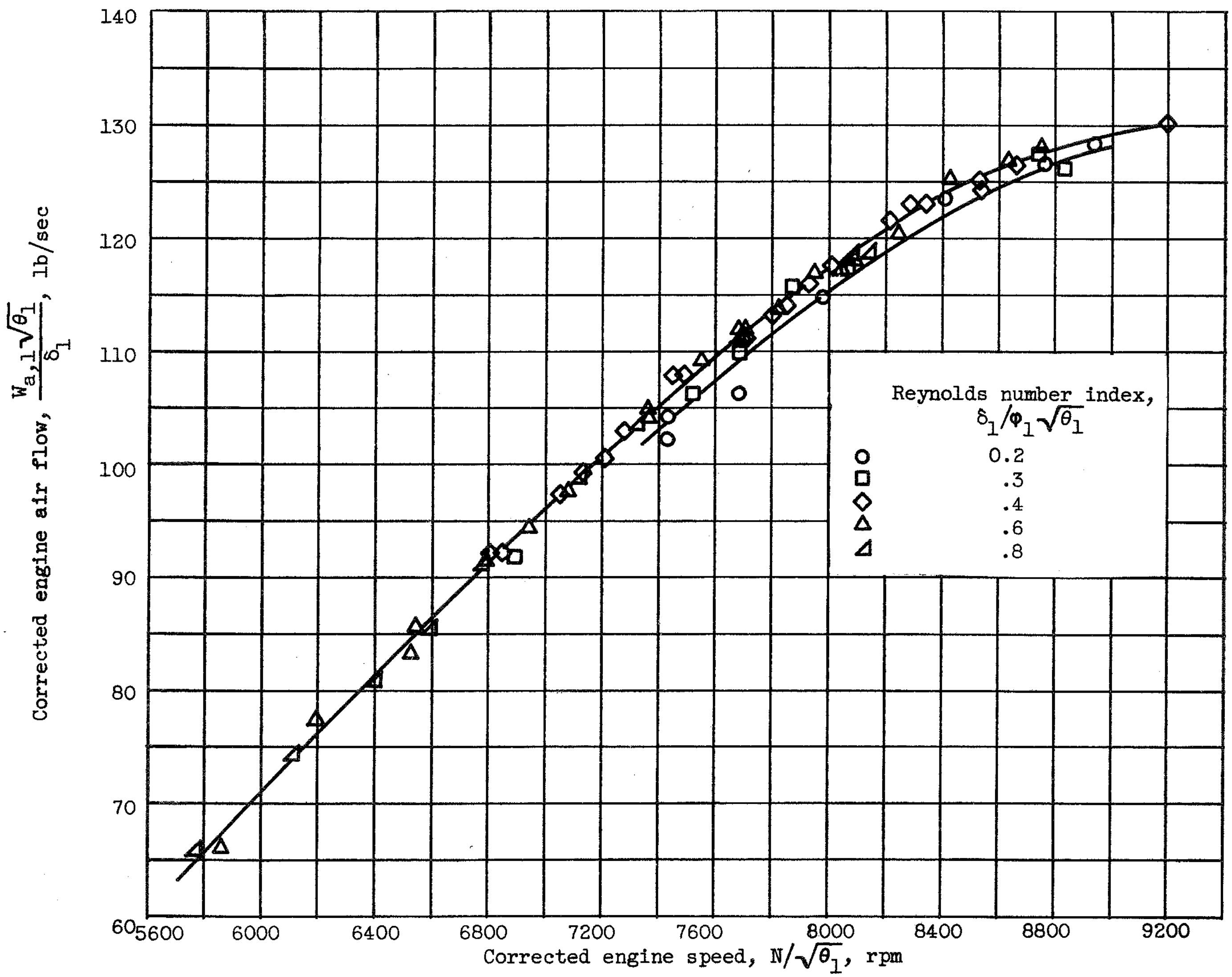


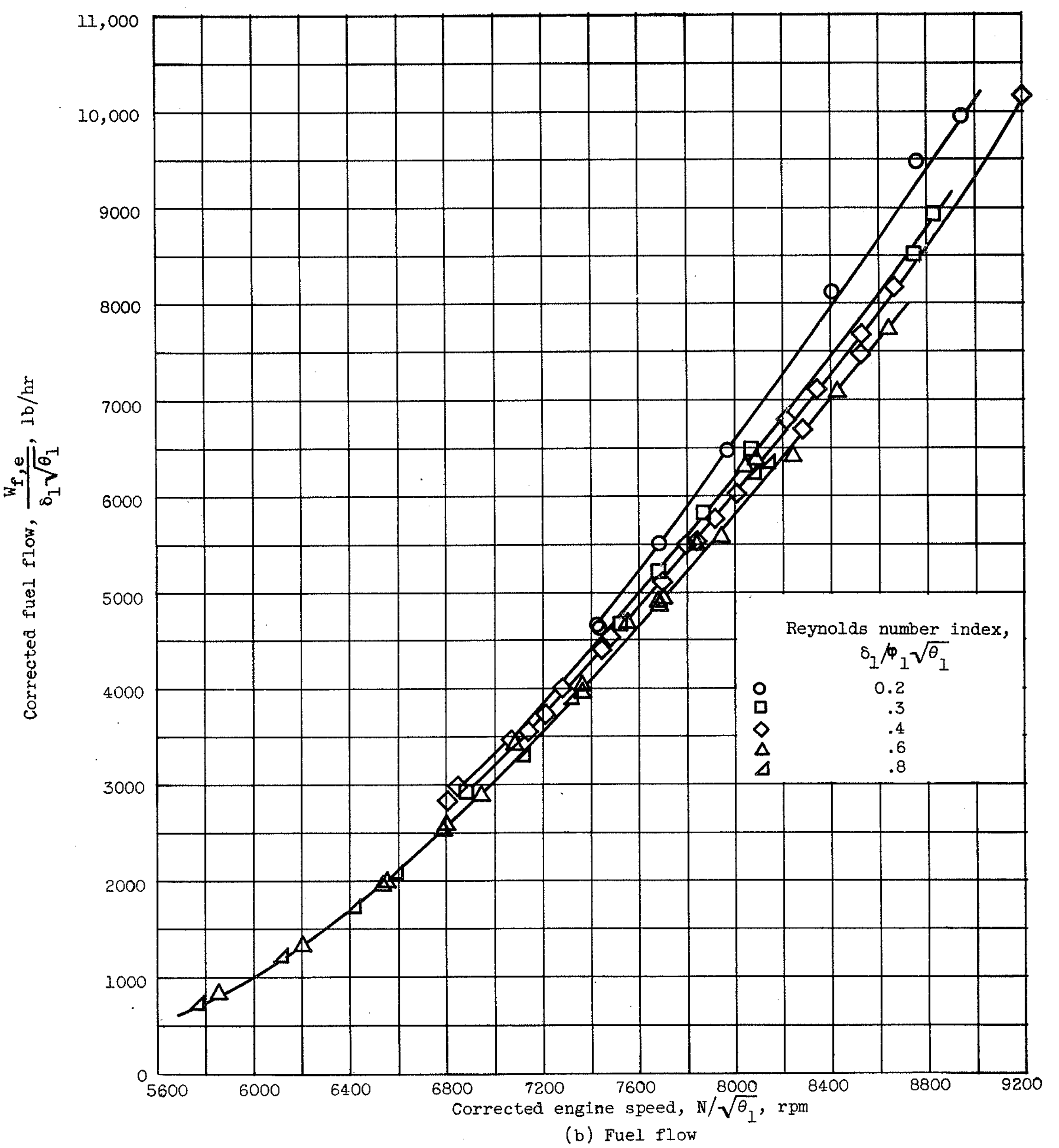
Station	Number of probes		
	Total pressure	Static pressure	Thermocouple
1	20	8	12
3	12	-	12
4	4	-	-
5	15	-	-
6	-	-	4
9	35	5	30

Figure 2. - Schematic diagram of engine showing instrumentation stations.



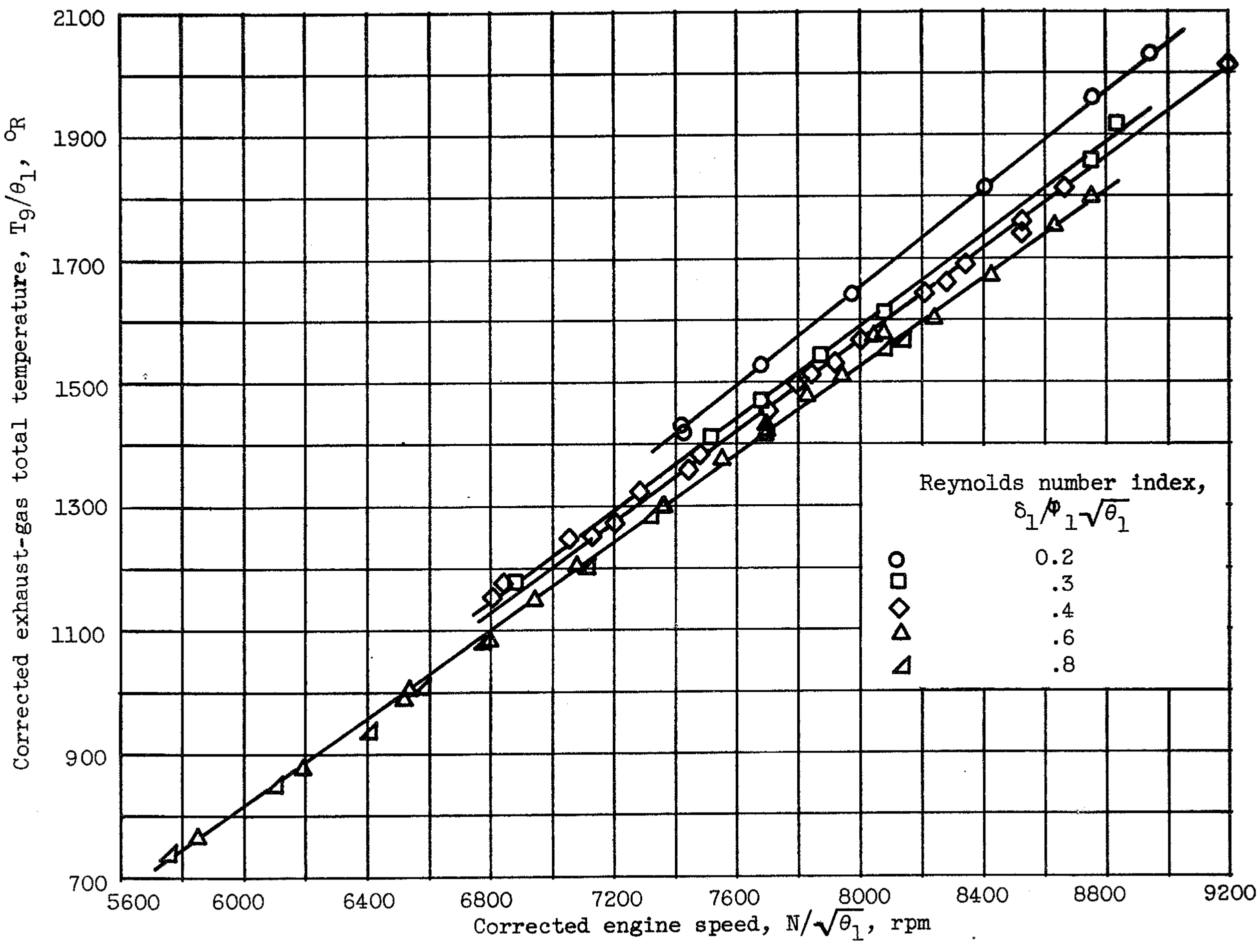
(a) Air flow

Figure 3. - Over-all engine performance for several values of Reynolds number indices.



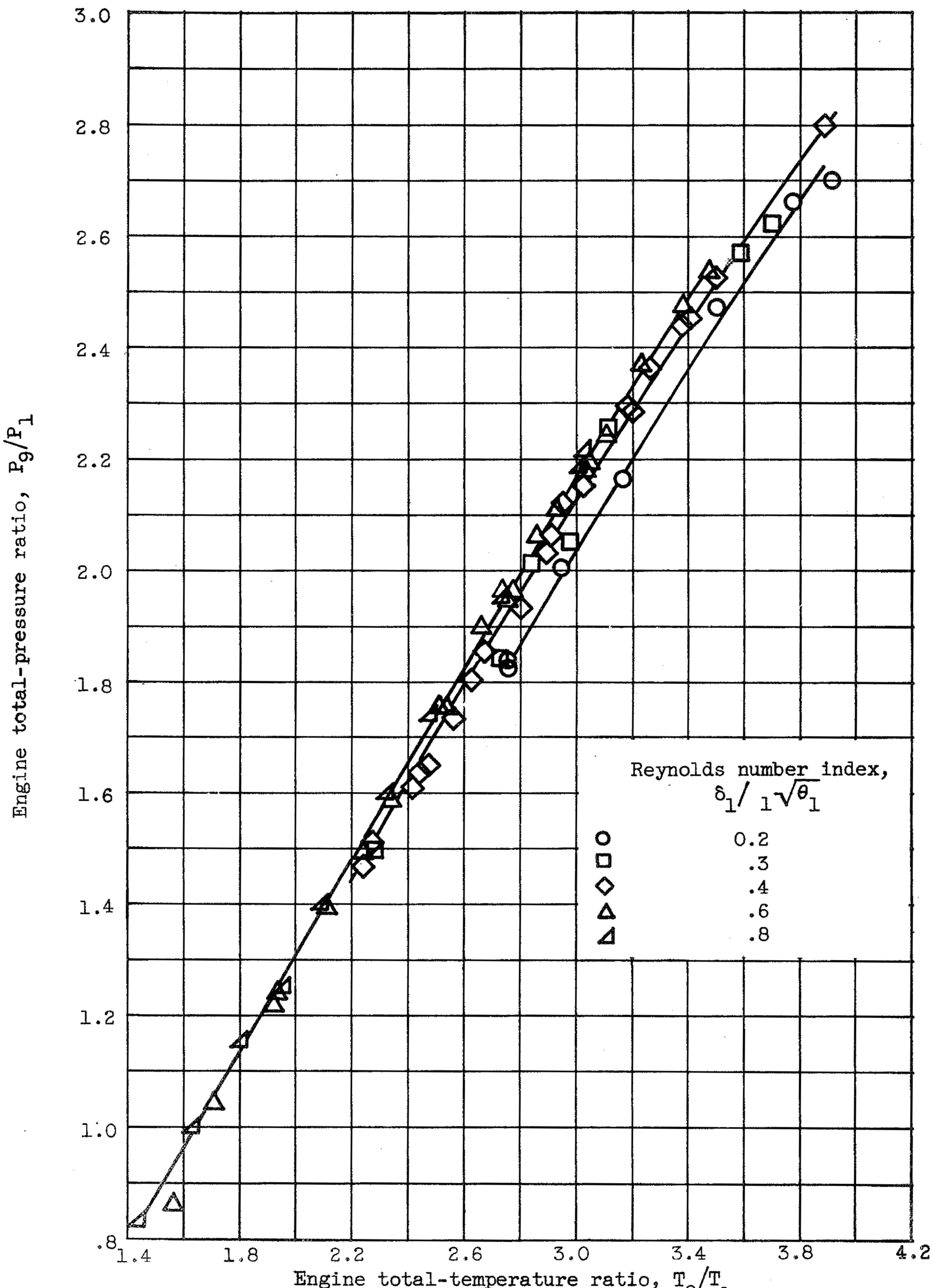
(b) Fuel flow

Figure 3. - Over-all engine performance for several values of Reynolds number indices.



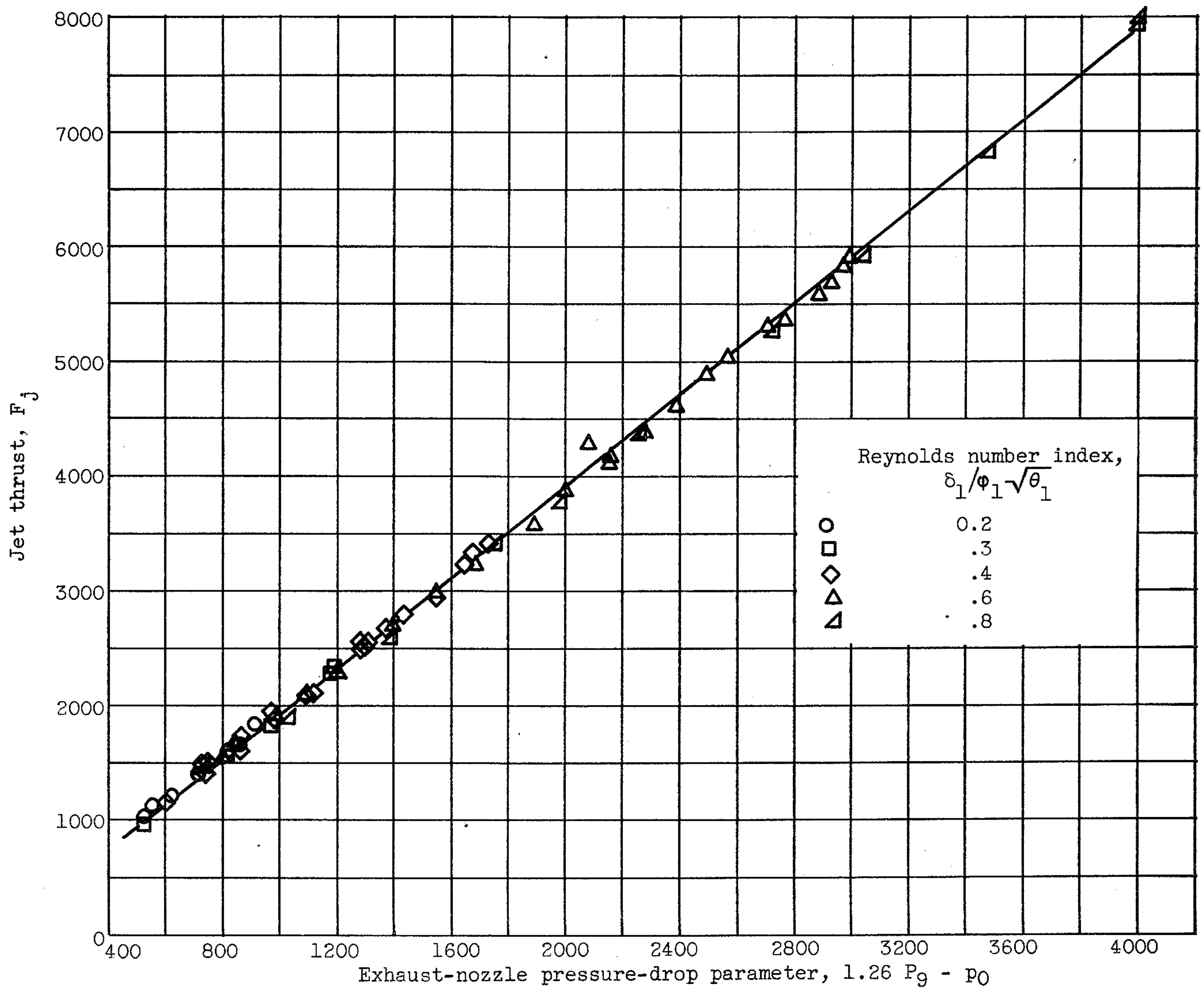
(c) Exhaust-gas total temperature.

Figure 3. - Over-all engine performance for several values of Reynolds number indices.



(d) Engine pumping characteristics.

Figure 3. - Over-all engine performance for several values of Reynolds number indices.



(e) Jet thrust.

Figure 3. - Over-all engine performance for several values of Reynolds number indices.

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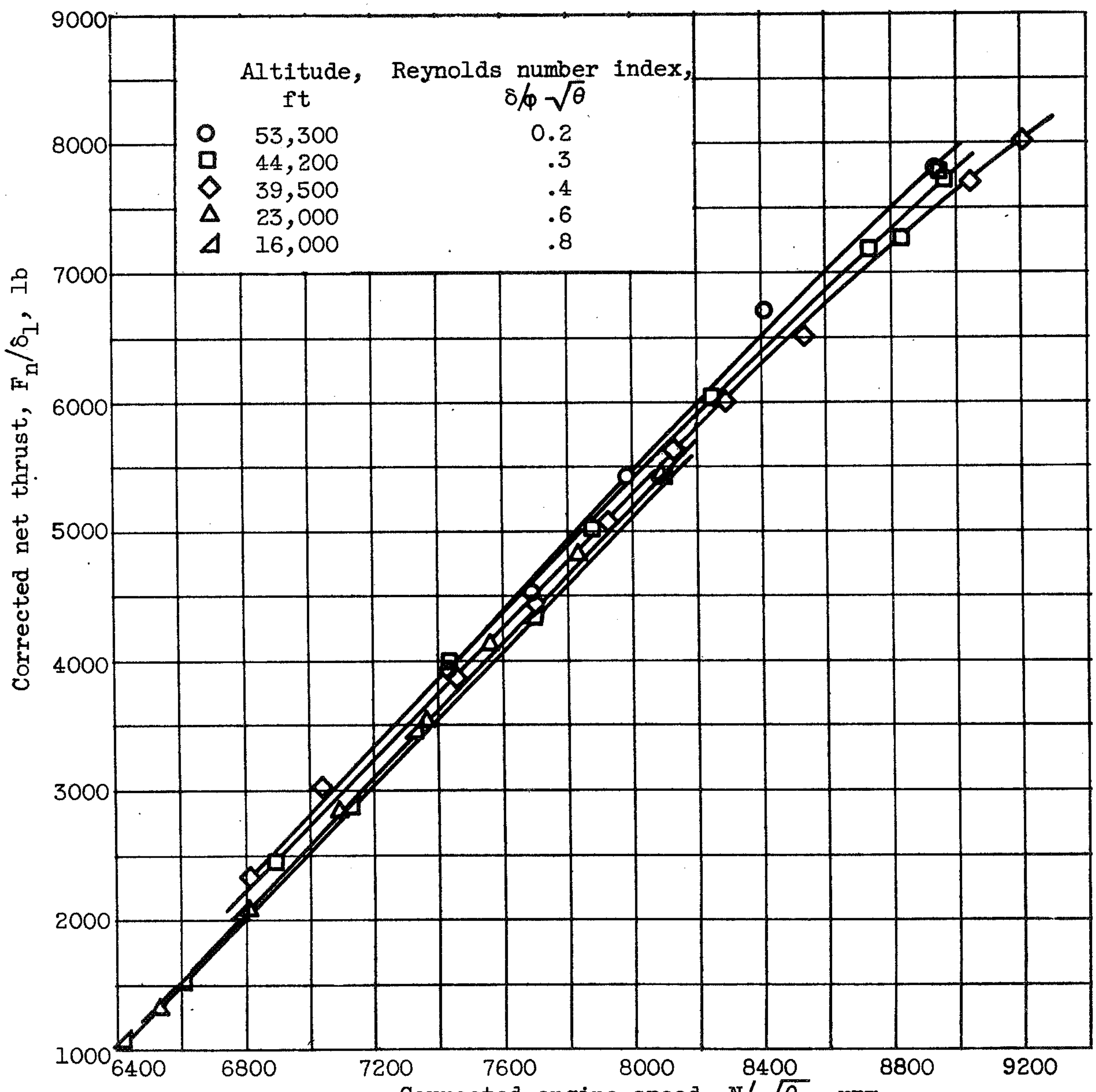
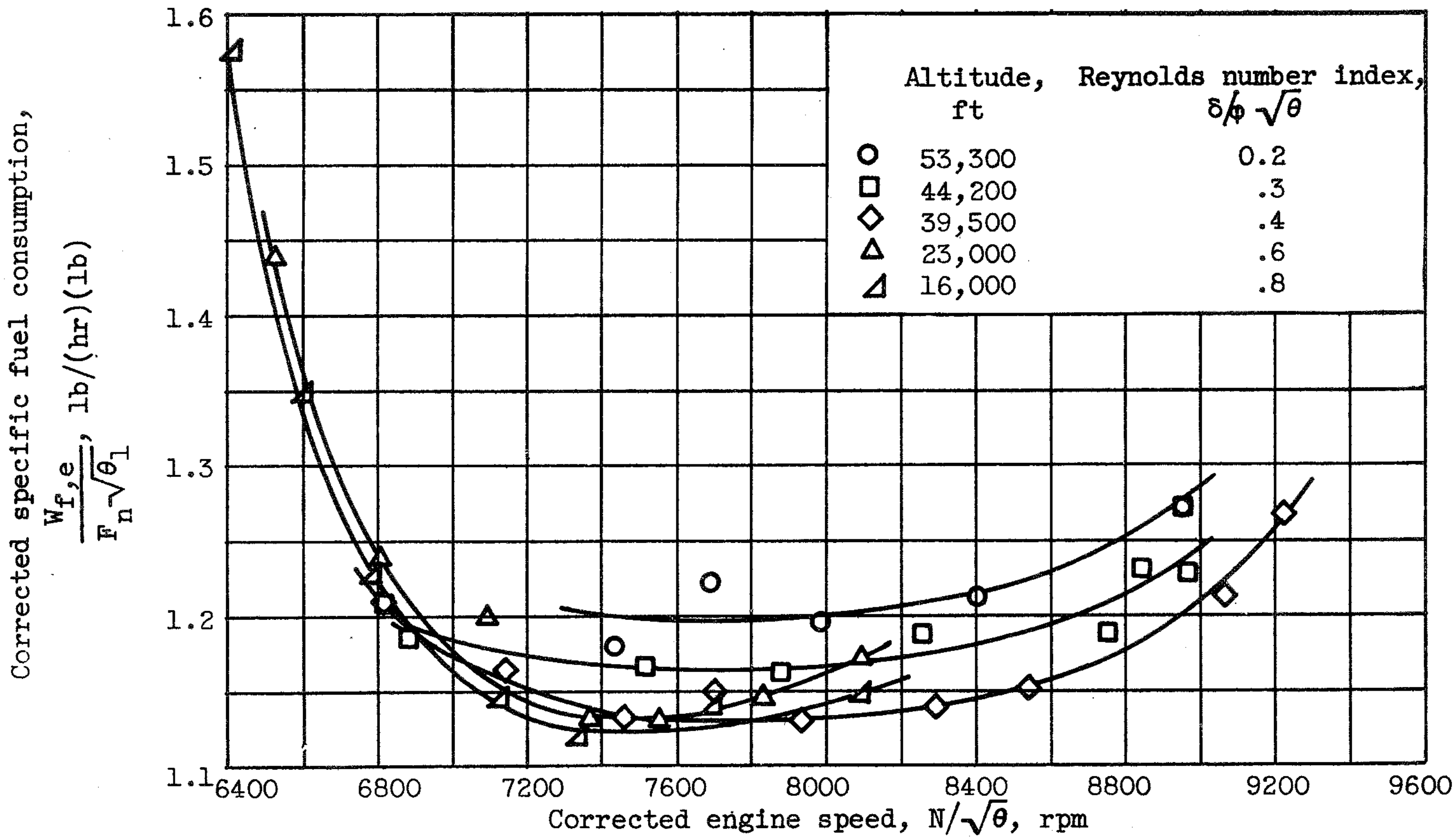


(f) Net thrust for flight Mach number of 0.8.

Figure 3. - Over-all engine performance for several values of Reynolds number indices.



(g) Specific fuel consumption for flight Mach number of 0.8.

Figure 3. - Over-all engine performance for several values of Reynolds number indices.

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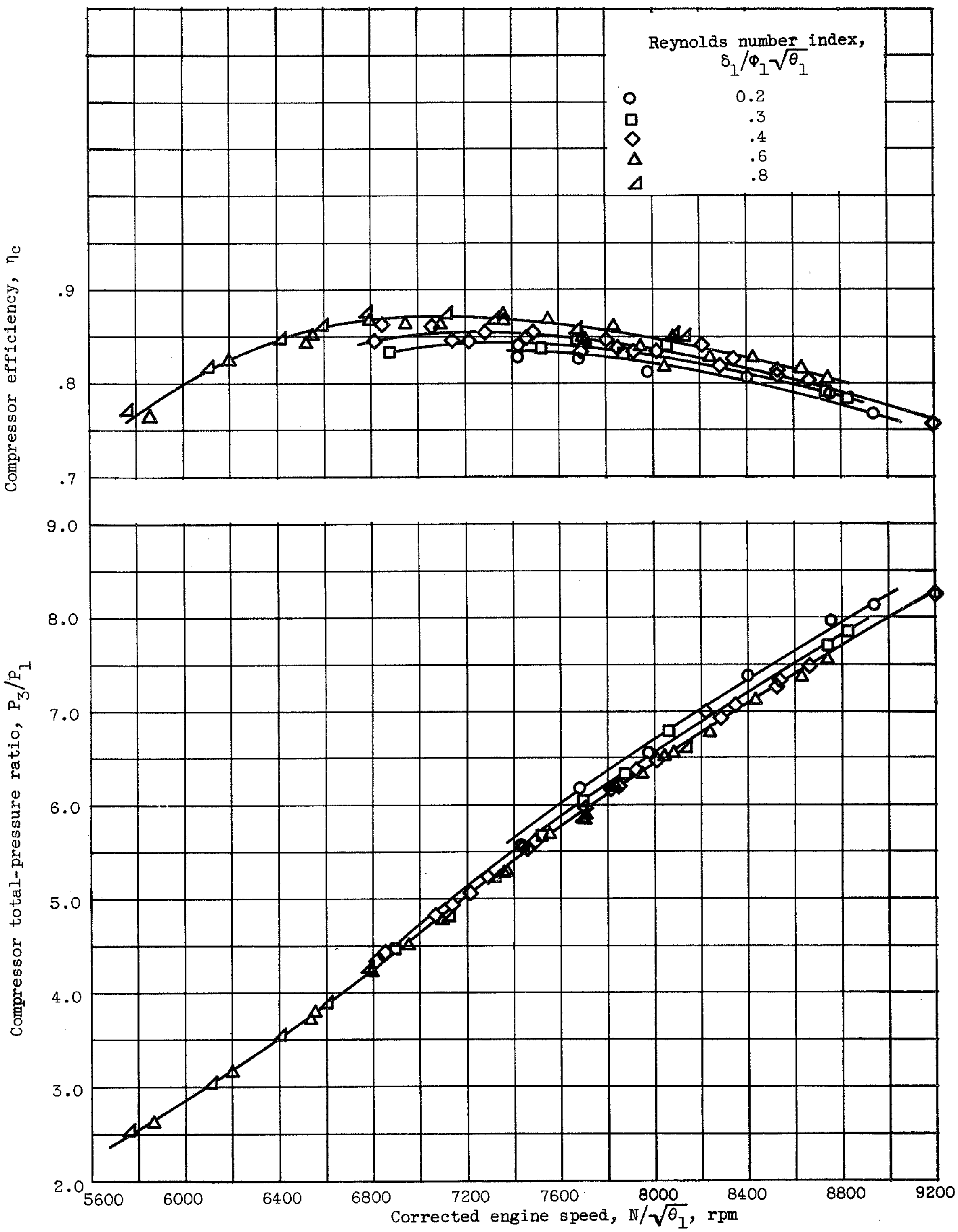

Figure 4. - Variation of compressor performance with corrected engine speed for several values of Reynolds number indices.

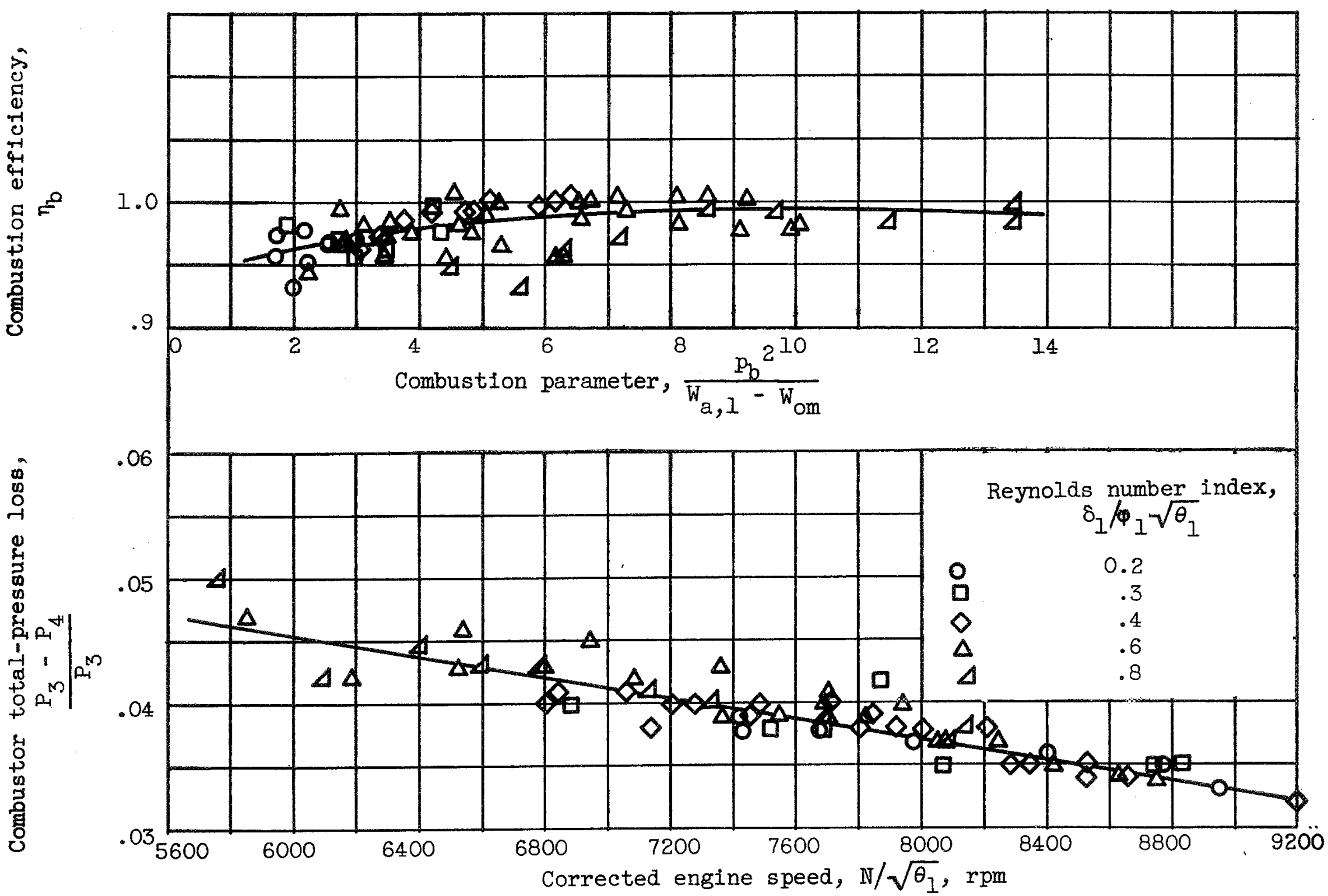

Figure 5. - Variation of combustor performance for several values of Reynolds number indices.

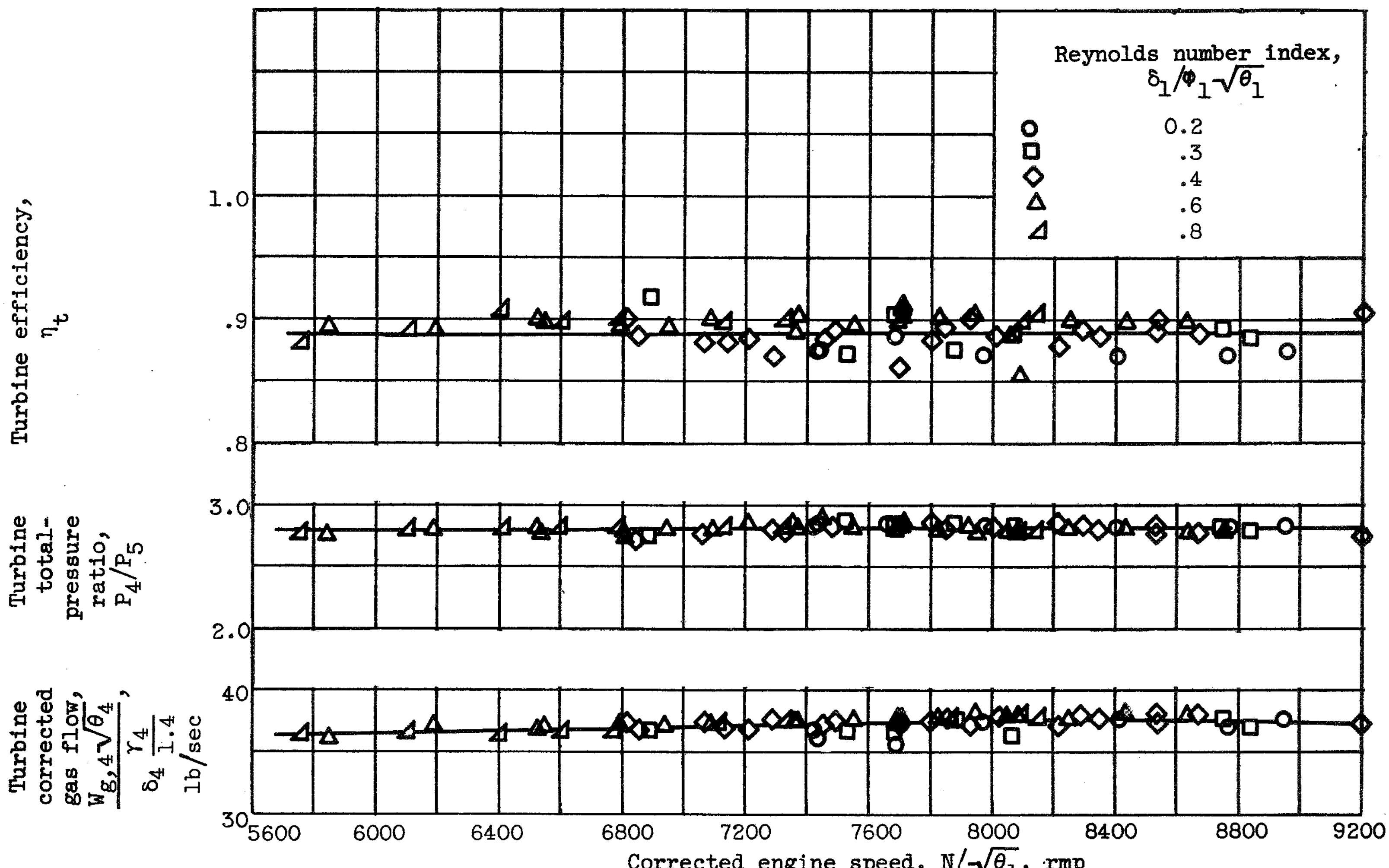

Figure 6. - Variation of turbine performance with corrected engine speed for several values of Reynolds number indices.

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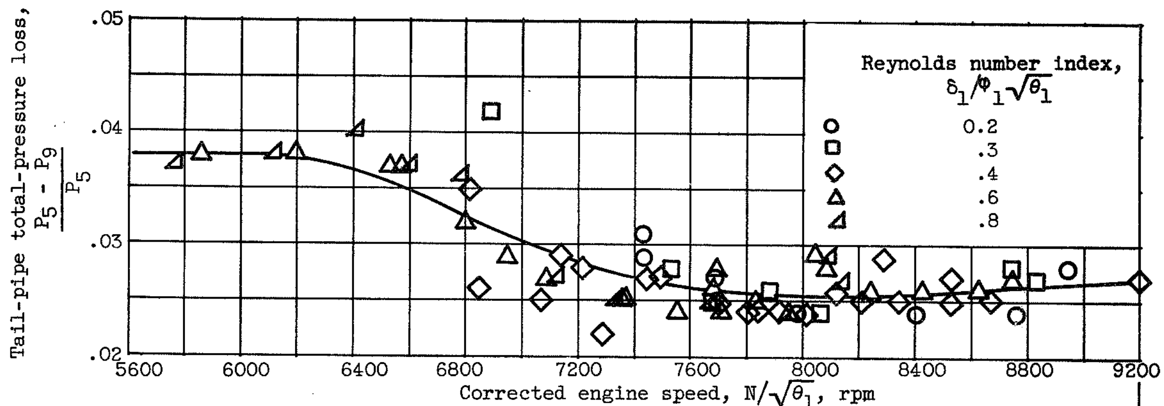

Figure 7. - Variation of tail-pipe total-pressure loss with corrected engine speed for several values of Reynolds number indices.

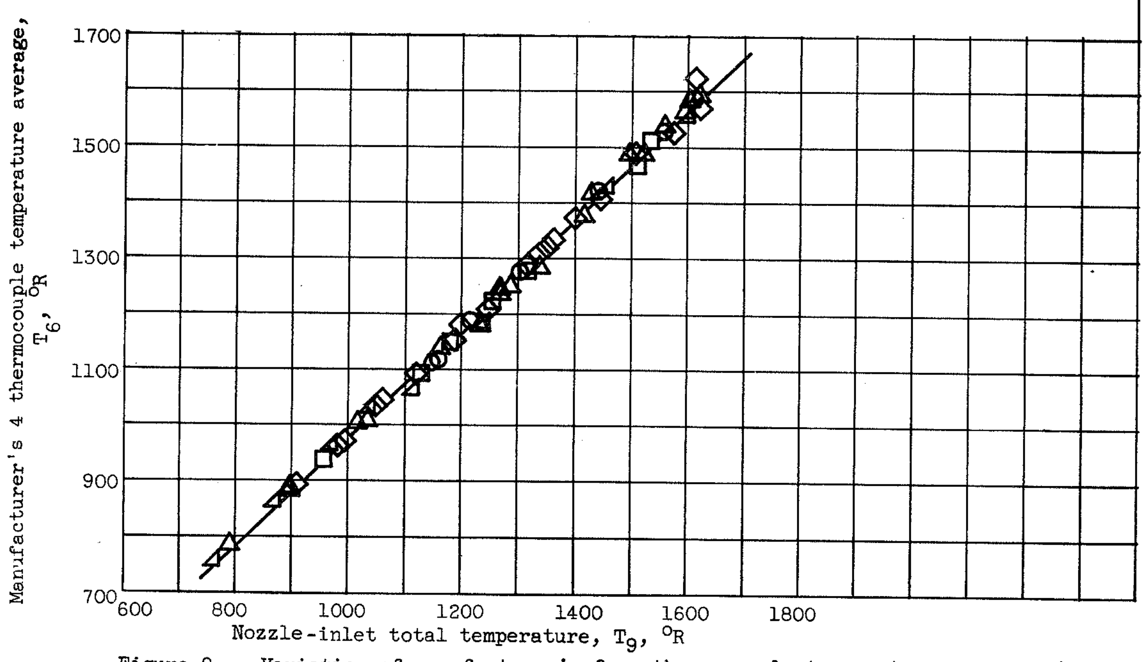

Figure 8. - Variation of manufacturer's four thermocouple temperature average at station 6 with NACA 30 thermocouple temperature average at station 9.

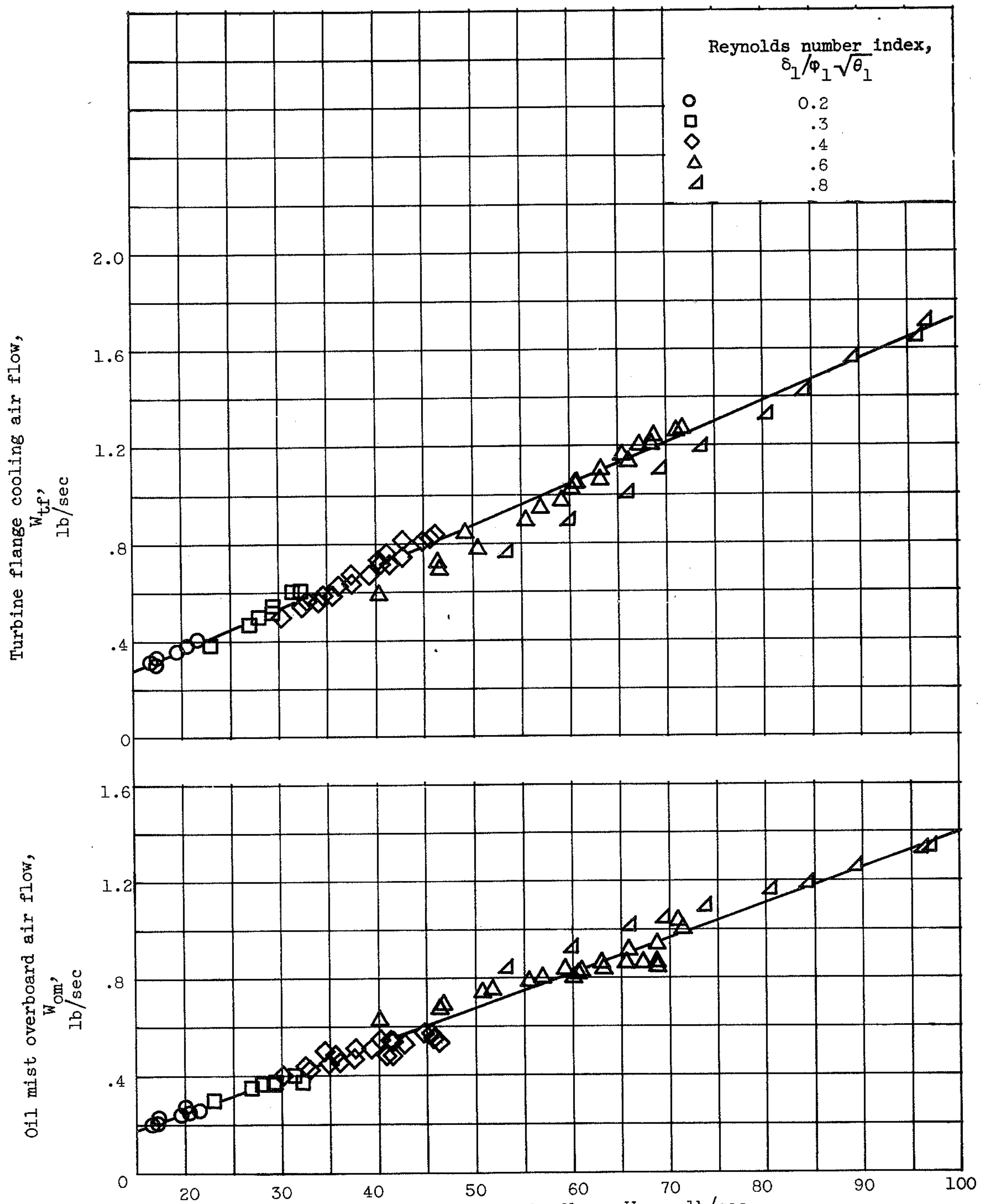

Figure 9. - Variation of turbine cooling and oil mist air flow with engine-inlet air flow for several values of Reynolds number indices.

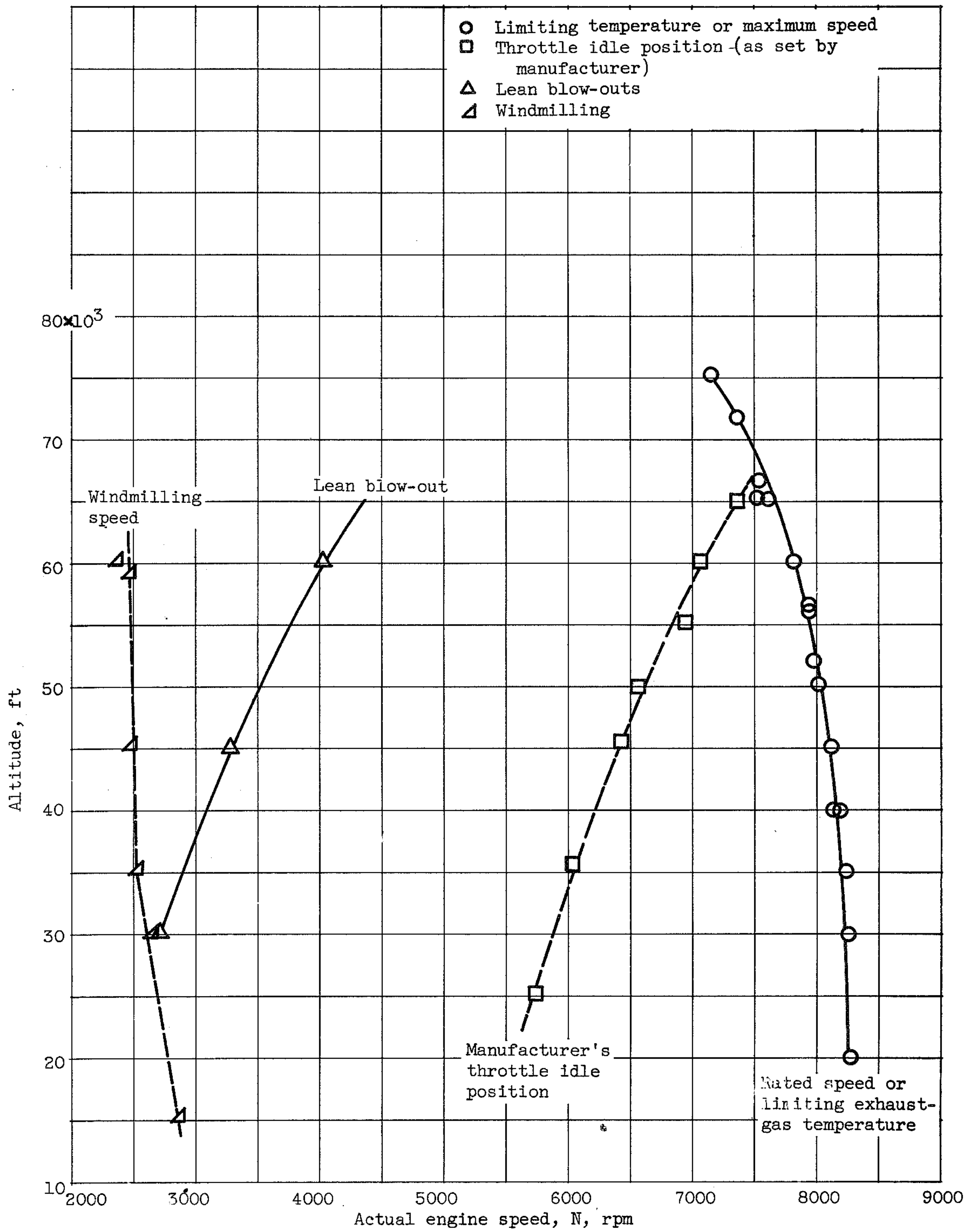

Figure 10. - Effect of altitude on engine operational characteristics at flight Mach number of 0.80.

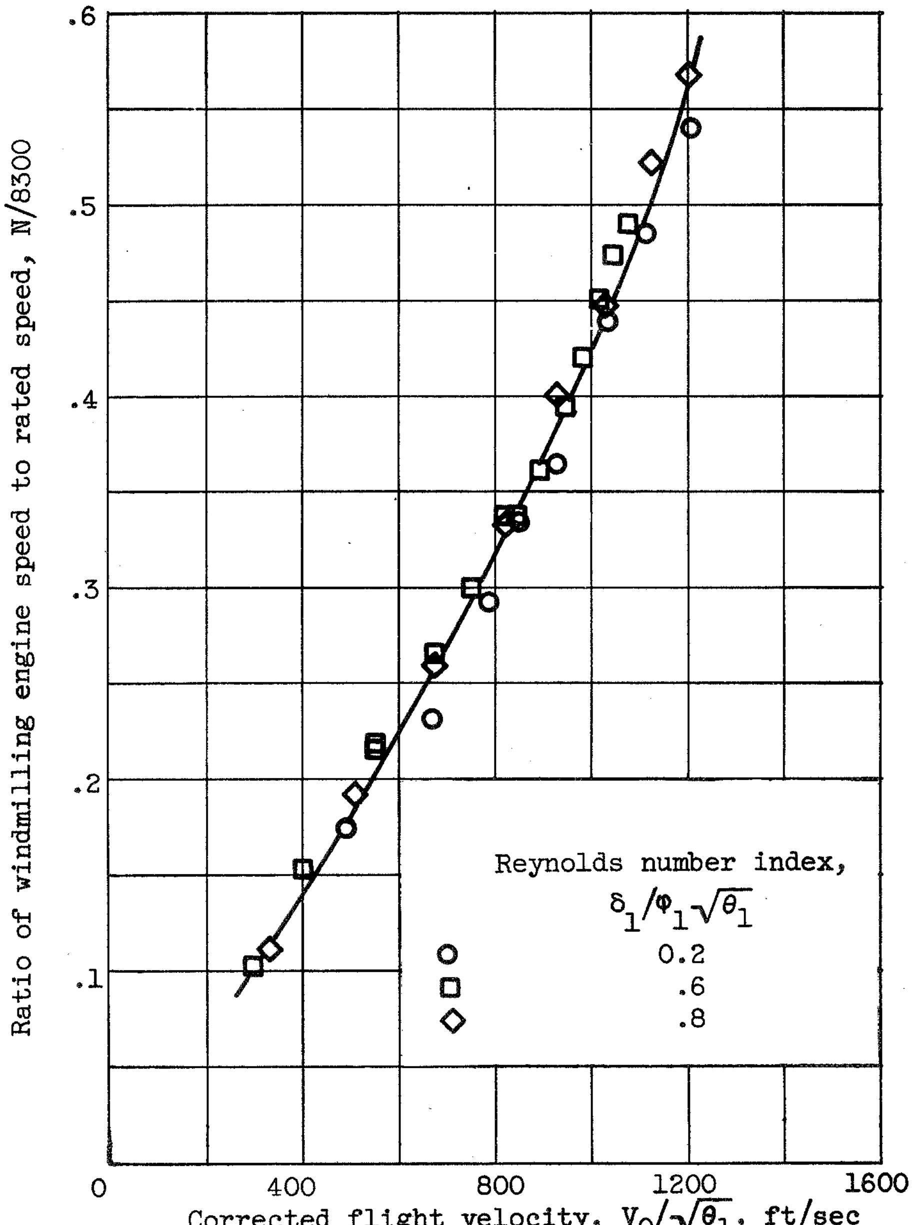

Figure 11. - Effect of flight velocity on windmilling speed for several values of Reynolds number indices.

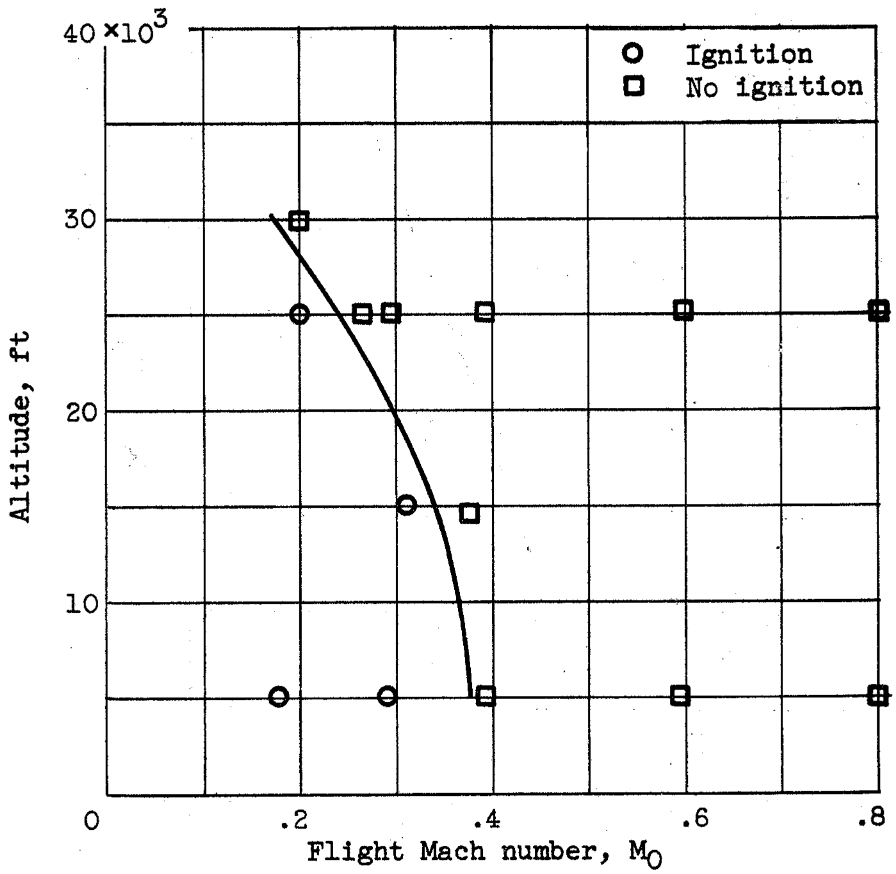

Figure 12. - Effect of altitude and Mach number on engine ignition characteristics.

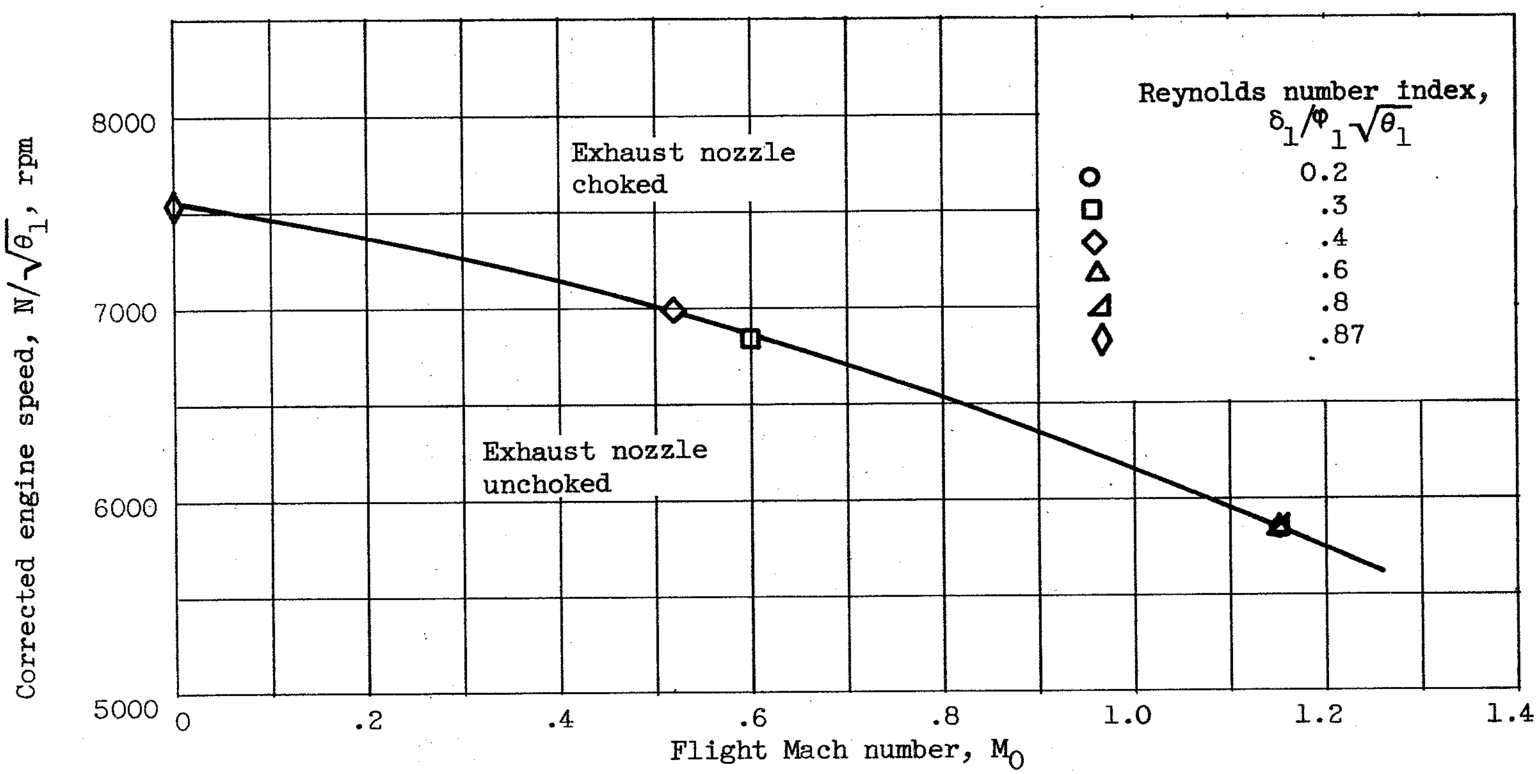

Figure 13. - Minimum corrected engine speeds at which critical flow existed in exhaust nozzle.

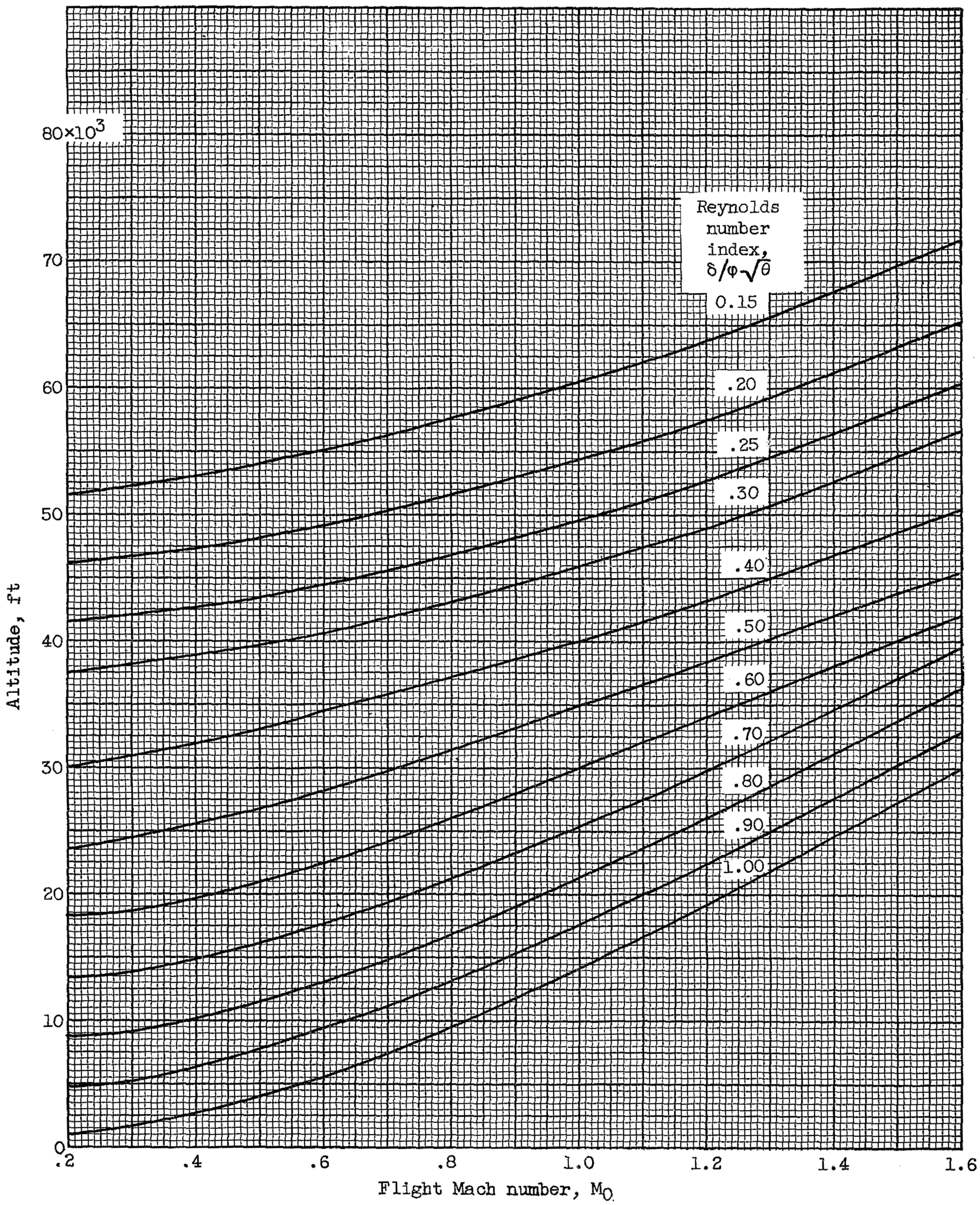

Figure 14. - Reynolds number index as a function of altitude and Mach number assuming 100 percent ram-pressure recovery.

PRELIMINARY ALTITUDE PERFORMANCE DATA FOR THE J65-B3 TURBOJET

ENGINE AT REYNOLDS NUMBER INDICES FROM 0.2 TO 0.8

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sjt - 8/23/54

Engines, Turbojet 3.1.3

Braithwaite, W. M. and Greathouse, W. K.

PRELIMINARY ALTITUDE PERFORMANCE DATA FOR THE J65-B3 TURBOJET ENGINE AT REYNOLDS NUMBER INDICES FROM 0.2 TO 0.8

Abstract

Altitude performance characteristics of the J65-B3 turbojet engine and its components were obtained at engine-inlet conditions corresponding to Reynolds number indices from 0.2 to 0.8 over a range of corrected engine speeds from 70 to 110 percent of rated speed. Engine operational limits up to an altitude of 75,000 feet along with ignition and windmilling characteristics were also obtained. The engine and component data are presented both in graphical and in tabulated form. The operational characteristics are presented in graphical form.

FORWARD

To permit expeditious transmittal of performance data to those concerned, figures and a tabulation of "preliminary data" are presented herein. Preliminary Data are test data that have not received the complete analysis and extensive cross-checking normally given a set of NACA data before release.